Final Exam Review Questions
PHY 2425 - Final Chapters

Section: 17–1 Topic: Thermal Equilibrium and Temperature Type: Numerical

12 A temperature of 14ºF is equivalent to

A) –10ºC B) 7.77ºC C) 25.5ºC D) 26.7ºC E) 47.7ºC

Ans: A

Section: 17–1 Topic: Thermal Equilibrium and Temperature Type: Numerical

13 A temperature difference of 9ºF is the same as a difference of

A) 5ºC B) 9ºC C) 20ºC D) 68ºC E) 100ºC

Ans: A

Section: 17–1 Topic: Thermal Equilibrium and Temperature Type: Numerical

14 The temperature at which the Celsius and Fahrenheit scales read the same is

A) 40ºC B) –40ºC C) 20ºF D) 68ºF E) 100ºC

Ans: B

Section: 17–2 Topic: Gas Thermometers & Absolute Temperature
Type: Numerical

16 A constant-volume gas thermometer reads 6.66 kPa at the triple point of water. What is the pressure reading at the normal boiling point of water?

A) 2.44 kPa B) 18.2 kPa C) 9.10 kPa D) 11.8 kPa E) 4.87 kPa

Ans: C

Section: 17–2 Topic: Gas Thermometers & Absolute Temperature
Type: Conceptual

17 Which of the following statements about absolute zero temperature is true?

A) At absolute zero all translational motion of the particles ceases.
B) At absolute zero all rotational motion of the particles ceases.
C) Absolute zero is defined at -273.15°C.
D) At absolute zero all the particles are at rest, except for the quantum motion.
E) All the above.

Ans: E

Section: 17–3 Topic: The Ideal Gas Law Type: Numerical

24 A large balloon is being filled with He from gas cylinders. The temperature is 25°C and the pressure is 1 atmosphere. The volume of the inflated balloon is 2500 m^3. What was the volume of He in the cylinders if the gas was under a pressure of 110 atmospheres and at a temperature of 12°C when in the gas cylinders?

A) 11 m^3 B) 22 m^3 C) 24 m^3 D) 15 m^3 E) 23 m^3

Ans: B

Section: 17–3 Topic: The Ideal Gas Law Type: Numerical

25 What mass of He gas occupies 8.5 liters at 0°C and 1 atmosphere? (The molar mass of He = 4.00 g/mol.)

A) 10.5 g B) 0.66 g C) 2.6 g D) 0.38 g E) 1.52 g

Ans: E

Section: 17–3 Topic: The Ideal Gas Law Type: Conceptual

27 A gas has a density *X* at standard temperature and pressure. What is the new density when the absolute temperature is doubled and the pressure increased by a factor of 3?

A) (2/3)*X* B) (4/3)*X* C) (3/4)*X* D) (6)*X* E) (3/2)*X*

Ans: E

Section: 17–3 Topic: The Ideal Gas Law Type: Numerical

28 Inside a sphere of radius 12 cm are 8.0×10^{23} gas molecules at a temperature of 50°C. What pressure do the gas molecules exert on the inside of the sphere?

A) 650×10^3 Pa
B) 370×10^3 Pa
C) 76.0×10^3 Pa
D) 160×10^3 Pa
E) 490×10^3 Pa

Ans: E

Section: 17–3 Topic: The Ideal-Gas Law Type: Numerical

30 The air in a balloon occupies a volume of 0.10 m^3 when at a temperature of 27ºC and a pressure of 1.2 atm. What is the balloon's volume at 7ºC and 1.0 atm? (The amount of gas remains constant.)

A) 0.022 m^3 B) 0.078 m^3 C) 0.089 m^3 D) 0.11 m^3 E) 0.13 m^3

Ans: D

Section: 17–3 Topic: The Ideal-Gas Law Type: Numerical

31 In a vacuum system, a container is pumped down to a pressure of 1.33×10^{-6} Pa at 20ºC. How many molecules of gas are there in 1 cm^3 of this container? (Boltzmann's constant $k = 1.38 \times 10^{-23}$ J/K)

A) 3.3×10^8 B) 4.8×10^9 C) 3.3×10^{14} D) 7.9×10^{12} E) 4.8×10^{12}

Ans: A

Section: 17–3 Topic: The Ideal-Gas Law Type: Numerical

32 A rigid container of air is at atmospheric pressure and 27ºC. To double the pressure in the container, heat it to

A) 54ºC B) 300ºC C) 327ºC D) 600ºC E) 327 K

Ans: C

Section: 17–3 Topic: The Ideal-Gas Law Type: Conceptual

34 If a mass of oxygen gas occupies a volume of 8 L at standard temperature and pressure, what is the change in the volume if the temperature is reduced by one half and the pressure is doubled?

A) It increases to 12 L.
B) It decreases to 6 L.
C) It increases to 24 L.
D) It decreases to 2 L.
E) It does not change.

Ans: D

Section: 17–3 Topic: The Ideal-Gas Law Type: Conceptual

35 A collection of oxygen molecules occupies a volume *V* at standard temperature and pressure. What is the new volume if the amount of oxygen is doubled and the pressure is tripled?

A) *V* B) (2/3)*V* C) (3/2)*V* D) 6*V* E) (5/9)*V*

Ans: B

Section: 17–3 Topic: The Ideal-Gas Law Type: Conceptual

36 If the pressure and volume of an ideal gas are both reduced to half their original value, the absolute temperature of the gas is

A) unchanged.
B) doubled.
C) halved.
D) increased by a factor of 4.
E) decreased by a factor of 4.

Ans: E

Section: 17–3 Topic: The Ideal-Gas Law Type: Numerical

38 Assume that helium is a perfect gas and that the volume of a cylinder containing helium is independent of temperature. A cylinder of helium at +85ºC has a pressure of 208 atm. The pressure of the helium when it is cooled to –55ºC is

A) –132 atm B) 127 atm C) 335 atm D) 132 atm E) 204 atm

Ans: B

Section: 17–3 Topic: The Ideal-Gas Law Type: Conceptual

39 The relationship between the pressure and the volume of a gas expressed by Boyle's law holds true

A) for some gases under any conditions.
B) if the density is constant.
C) if the container of the gas can expand with increasing pressure.
D) if the temperature is constant.
E) for all gases under any conditions.

Ans: D

Section: 17–3 Topic: The Ideal-Gas Law Type: Numerical

42 The air around us has 78% nitrogen and 21% oxygen. If the pressure is 1 atm, the pressure due to oxygen is

A) 0.21 atm B) 0.78 atm C) 1 atm D) 0.5 atm E) 0.67 atm

Ans: A

Section: 17–3 Topic: The Ideal-Gas Law Type: Numerical

43 A cylinder of volume 50 L contains oxygen gas at a pressure of 2 atm. If nitrogen gas of volume 25 L and at pressure 1 atm is added to the oxygen cylinder, the new pressure is

A) 2 atm B) 3 atm C) 2.5 atm D) 3.5 atm E) 4 atm

Ans: C

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

44 A room measures 3 m × 4 m × 2 m and is at 15°C and 1 atm. When the temperature is increased to 25°C, the number of molecules that escaped from the room is, assuming that the pressure stays at 1 atm

A) 6.1×10^{26}

B) 2.1×10^{25}

C) 2.9×10^{26}

D) 1.2×10^{28}

E) 7.04×10^{27}

Ans: B

Section: 17–3 Topic: The Ideal-Gas Law Type: Numerical

47 An ideal gas whose original temperature and volume are 27ºC and 0.283 m^3 undergoes an isobaric expansion. If the final temperature is 87ºC, then the final volume is approximately

A) 0.0340 m^3 B) 0.0552 m^3 C) 0.170 m^3 D) 0.340 m^3 E) 1.45 m^3

Ans: D

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

49 At what common Celsius temperature is the rms velocity of oxygen molecules (molar mass = 32 g/mol) double that of hydrogen molecules (molar mass = 2.0 g/mol)?

A) −50 B) zero C) no such temperature exists D) 2.0 E) 16

Ans: C

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Conceptual

50 Two monoatomic gases, helium and neon, are mixed in the ratio of 2 to 1 and are in thermal equilibrium at temperature T (the molar mass of neon = 5 × the molar mass of helium). If the average kinetic energy of each helium atom is U, calculate the average energy of each neon atom.

A) U B) $0.5U$ C) $2U$ D) $5U$ E) $U/5$

Ans: A

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

51 Two monoatomic gases, helium and neon, are mixed in the ratio of 2 to 1 and are in thermal equilibrium at temperature T (the molar mass of helium = 4.0 g/mol and the molar mass of neon = 20.2 g/mol). If the average kinetic energy of each helium atom is 6.3×10^{-21} J, calculate the temperature T.

A) 304 K B) 456 K C) 31 K D) 31°C E) 101 K

Ans: A

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

55 A hailstorm causes an average pressure of 1.4 N/m^2 on the 200-m^2 flat roof of a house. The hailstones, each of mass 7.0×10^{-3} kg, have an average velocity of 10 m/s perpendicular to the roof and rebound after hitting the roof with the same speed. How many hailstones hit the roof each second?

A) 4000 B) 2000 C) 1000 D) 10 E) 800

Ans: B

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

57 At what Kelvin temperature does the rms speed of the oxygen (O_2) molecules in the air near the surface of the earth become equal to the escape speed from the earth? (R = 8.31 J/mol · K; molar mass of O_2 gas is 32 g/mol; radius of the earth $R_E = 6.37 \times 10^6$ m; the escape speed from the earth is 11.2 km/s)

A) 4.8×10^5 K
B) 8.0×10^4 K
C) 1.6×10^5 K
D) 1.1×10^4 K
E) 3.6×10^5 K

Ans: C

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Conceptual

59 If the absolute temperature of a gas is doubled, what is the change in the rms speed of its molecules?

A) no change
B) increases by a factor of 2
C) decreases by a factor of 2
D) increases by a factor of $\sqrt{2}$
E) decreases by a factor of $\sqrt{2}$

Ans: D

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Factual

61 Which of the following is an assumption that is made in the kinetic theory of gases?

A) Molecules are not described by Newton's laws.
B) Molecules make up only a small fraction of the volume occupied by a gas.
C) Molecules collide inelastically.
D) The total number of molecules is actually very small.
E) There are forces acting on the molecules at all times.

Ans: B

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

63 A volume of an ideal gas goes through a temperature change from 20ºC to 60ºC. The relation between the average molecular kinetic energy at 20ºC (K_1) and that at 60ºC (K_2) is

A) $K_1 = K_2$
B) $K_1 = 0.33\ K_2$
C) $K_1 = 3\ K_2$
D) $K_1 = 0.88\ K_2$
E) $K_1 = 1.14\ K_2$

Ans: D

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

66 On the basis of the kinetic theory of gases, when the absolute temperature is doubled, the average kinetic energy of the gas molecules changes by a factor of

A) 16 B) 2 C) $\sqrt{2}$ D) 4 E) 0.5

Ans: B

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

68 A room measures 3 m × 4 m × 2 m and is at 20°C and 1 atm. Assuming that it only has the two diatomic gases, N_2 and O_2, the amount of kinetic energy in the gases is

A) 3.6 MJ
B) 6.1 MJ
C) 0.25 MJ
D) 0.41 MJ
E) none of the above

Ans: B

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

69 A room measures 3 m × 4 m × 2 m and is at 15°C and 1 atm. Assuming that it only has the two diatomic gases, N_2 and O_2, how much heat is needed to increase the temperature to 25°C? (Ignore the loss in air as the temperature heats up.)

A) 8.4×10^4 J
B) 1.3×10^5 J
C) 1.7×10^5 J
D) 2.1×10^5 J
E) none of the above

Ans: D

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

74 The rms speed of oxygen molecules is 460 m/s at 0ºC. The molecular weight of oxygen is 8 times the molecular weight of helium. The rms speed of helium at 40ºC is approximately

A) 3.68 km/s B) 1.84 km/s C) 1.40 km/s D) 880 m/s E) 440 m/s

Ans: C

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Numerical

76 If the rms speed of nitrogen molecules (molecular weight of N_2 is 28 g/mol) at 273 K is 492 m/s, the rms speed of oxygen molecules (molecular weight of O_2 is 32 g/mol) at the same temperature is approximately

A) 430 m/s B) 461 m/s C) 492 m/s D) 526 m/s E) 562 m/s

Ans: B

Section: 17–4 Topic: The Kinetic Theory of Gases Type: Conceptual

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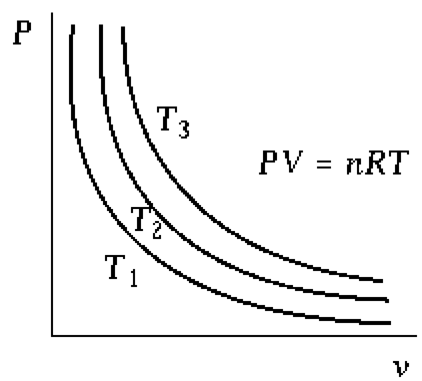


The isotherm that corresponds to the highest temperature is the one labeled

A) T_1

B) T_2

C) T_3

D) The isotherms correspond to the same temperature

E) none of these is correct

Ans: C

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

1 Two liquids, *A* and *B*, are mixed together, and the resulting temperature is 22°*C*. If liquid *A* has mass *m* and was initially at temperature 35°C, and liquid *B* has mass 3*m* and was initially at temperature 11°C, calculate the ratio of the specific heats of *A* divided by *B*.

A) 0.85 B) 2.5 C) 1.2 D) 0.45 E) 0.94

Ans: B

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

2 Two liquids, *A* and *B*, are mixed together. Liquid *A* has mass *m* and was initially at temperature 40°C, and liquid *B* has mass 2*m* and was initially at temperature 5°C. The specific heat of liquid *A* is 1.5 times that of liquid *B*.
Calculate the final temperature of the mixture.

A) 33.5°C B) 14.3°C C) 17.0°C D) 20.0°C E) 25.7°C

Ans: D

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

3 The quantity of heat absorbed by a body is determined from the formula $Q = cm(T_f - T_i)$. A certain metal has a specific heat c = 0.21 cal/g Cº and a mass $m = 25.6$ g. The initial temperature is $T_i = 34.6$ºC, and the final temperature $T_f = 54.6$ºC. The quantity of heat absorbed is

A) +23 cal B) +0.23 cal C) +14 cal D) +110 cal E) +207 cal

Ans: D

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Conceptual

4 Aluminum has a specific heat more than twice that of copper. Identical masses of aluminum and copper, both at 0ºC, are dropped together into a can of hot water. When the system has come to equilibrium,

A) the aluminum is at a higher temperature than the copper.
B) the copper is at a higher temperature than the aluminum.
C) the aluminum and copper are at the same temperature.
D) the difference in temperature between the aluminum and the copper depends on the amount of water in the can.
E) the difference in temperature between the aluminum and the copper depends on the initial temperature of the water in the can.

Ans: C

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Conceptual

6 A system has a heat capacity of 100 J. This means

A) it is possible to extract the 100 J of heat and convert it to work.
B) it is possible to transfer the 100 J of heat to the environment.
C) some of the heat capacity can be converted to work.
D) some of the heat capacity can be transferred to another system if there is a temperature difference.
E) (C) and (D)

Ans: E

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

8 A lake with 8.0×10^9 kg of water, which has a specific heat of 4180 J/kg · C°, warms from 10 to 15ºC. The amount of heat transferred to the lake is

A) 2.5×10^3 J
B) 1.7×10^{14} J
C) 4.0×10^{15} J
D) 1.7×10^{16} J
E) 2.8×10^{16} J

Ans: B

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

10 To raise the temperature of a 2.0-kg piece of metal from 20º to 100ºC, 61.8 kJ of heat is added. What is the specific heat of this metal?

A) 0.39 kJ/kg · K
B) 0.31 kJ/kg · K
C) 1.6 kJ/kg · K
D) 1.2 kJ/kg · K
E) 0.77 kJ/kg · K

Ans: A

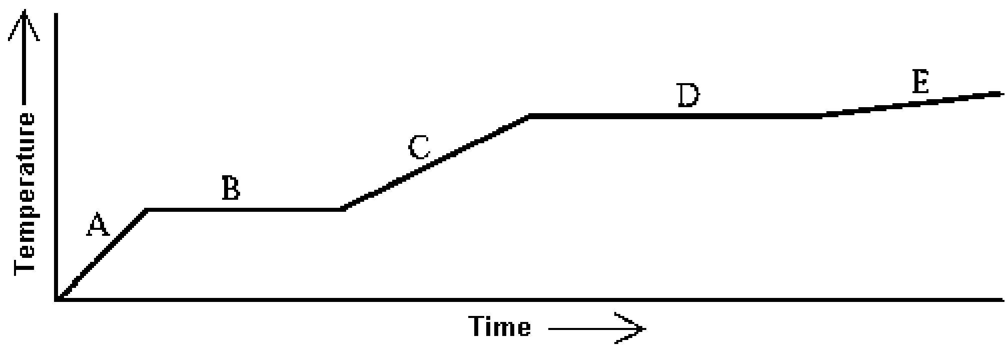
Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

11 A 250-g piece of lead is heated to 100ºC and is then placed in a 400-g copper container holding 500 g of water. The specific heat of copper is c = 0.386 kJ/kg · K. The container and the water had an initial temperature of 18.0ºC. When thermal equilibrium is reached, the final temperature of the system is 19.15ºC. If no heat has been lost from the system, what is the specific heat of the lead? (the specific heat of water is 4.180 kJ/kg · K)

A) 0.119 kJ/kg · K
B) 0.128 kJ/kg · K
C) 0.110 kJ/kg · K
D) 0.0866 kJ/kg · K
E) 0.0372 kJ/kg · K

Ans: B

Use the following to answer questions 12-14:



Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

17 A 1.0-kg piece of marble at 100ºC is dropped into 2.5 kg of water at 1.0ºC and the resulting temperature is 7.0ºC. The specific heat of the marble is approximately

A) 0.16 kcal/kg · Cº
B) 0.75 kcal/kg · Cº
C) 0.61 kcal/kg · Cº
D) 0.30 kcal/kg · Cº
E) 0.26 kcal/kg · Cº

Ans: A

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

18 Glass beads of mass 100 g and specific heat 0.20 cal/g · Cº are heated to 90ºC and placed in a 300-g glass beaker containing 200 g of water at 20ºC. When equilibrium is reached, the temperature is approximately

A) 23ºC B) 25ºC C) 27ºC D) 32ºC E) 39ºC

Ans: B

Section: 18–1 Topic: Heat Capacity and Specific Heat Type: Numerical

20 The molar specific heat of copper is 24.5 J/(mol·K). The amount of heat needed to raise 126 g of copper by 2C° is

A) 24.5 J B) 49 J C) 12.3 J D) 98 J E) 147 J

Ans: D

Section: 18–2 Topic: Change of Phase and Latent Heat Type: Numerical

26 A 2.0-kg mass of iron (specific heat = 0.12 kcal/kg°C) at a temperature of 430°C is dropped into 0.4 kg of ice and 0.4 kg of water both at 0°C. With no heat losses to the surroundings, the equilibrium temperature of the mixture is approximately

A) 0°C B) 100°C C) 23°C D) 69°C E) 87°C

Ans: D

Section: 18–2 Topic: Change of Phase and Latent Heat Type: Numerical

28 A 3-kg mass of metal of specific heat = 0.1 kcal/kg°C at a temperature of 600°C is dropped into 1.0 kg water at 20°C. With no heat losses to the surroundings, determine the equilibrium temperature of the mixture, and if it is 100°C, calculate what mass of water is turned into steam at this temperature.

A) 100°C and 110 g of steam
B) 100°C and 150 g of steam
C) 100°C and 130 g of steam
D) 100°C and 70 g of steam
E) The equilibrium temperature is not 100°C.

Ans: C

Section: 18–2 Topic: Change of Phase and Latent Heat Type: Conceptual

31 On a hot summer day, water collects on the outside of a glass of ice lemonade. The water comes from

A) inside the glass since glass is porous.
B) the condensation of the water vapor due the fact that the glass is much colder than the air.
C) the straw you use to drink your lemonade.
D) the mixture of water and lemonade.
E) It is one of the mysteries of life.

Ans: B

Section: 18–2 Topic: Change of Phase and Latent Heat Type: Numerical

32 A container contains a 200 mL of 100% proof alcohol (i.e., it has 50% ethyl alcohol and 50% water by volume) at 20°C. How much heat is needed to bring the mixture to the boiling point of the alcohol? (assume that the specific heat in the 100% proof can be treated as due to the alcohol and water separately, and the density, boiling point and specific heat of alcohol are 0.81 g/cm^3, 78°C, and 2.4 J/(g·C°), respectively)

A) 32650 J
B) 35525 J
C) 11136 J
D) 17400 J
E) 48557 J

Ans: B

Section: 18–2 Topic: Change of Phase and Latent Heat Type: Numerical

33 A container contains a 200 mL of 100% proof alcohol (i.e., it has 50% ethyl alcohol and 50% water by volume) at the boiling point of the alcohol. How long does it take to distill (boil) all the alcohol if heat is supplied at a rate of 100 W? (The density and latent heat of vaporization of ethyl alcohol are 0.81 g/cm^3, and 879 kJ/kg.)

A) 712 s B) 1110 s C) 450 s D) 1450 s E) 950 s

Ans: A

Section: 18–3 Topic: Joule's Experiment and the First Law... Type: Numerical

48 A 6.0-g lead bullet traveling at 300 m/s penetrates a wooden block and stops. If 50 percent of the initial kinetic energy of the bullet is converted into thermal energy in the bullet, by how much does the bullet's temperature increase? (The specific heat of lead is 128 J/kg · K.)

A) 0.17° C B) 1.8×10^2 ºC C) 17 ºC D) 3.5×10^2 ºC E) 35 ºC

Ans: B

Section: 18–3 Topic: Joule's Experiment and the First Law... Type: Factual

53 A state variable is one that allows other variables to be determined using a relationship. Which of the following variables are state variables?

A) P, V, and T
B) Internal energy, U
C) W and Q
D) (A) and (B)
E) (A), (B), and (C)

Ans: D

Section: 18–3 Topic: Joule's Experiment and the First Law... Type: Conceptual

54 The first law of thermodynamics has as its basis the same fundamental principle as

A) the continuity principle.
B) conservation of energy
C) Newton's law of universal gravitation.
D) static equilibrium.
E) the conservation of linear momentum.

Ans: B

Section: 18–4 Topic: The Internal Energy of an Ideal Gas Type: Numerical

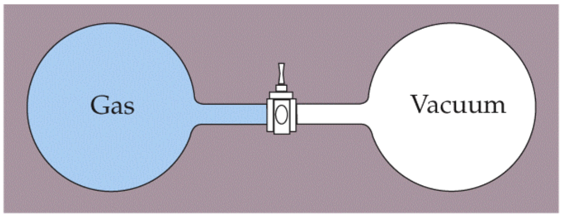
57 In a certain process, 500 cal of heat are supplied to a system consisting of a gas confined in a cylinder. At the same time, 500 J of work are done by the gas by expansion. The increase in thermal energy of the gas is approximately

A) zero B) 1.00 kJ C) 1.59 kJ D) 2.09 kJ E) 2.59 kJ

Ans: C

Section: 18–4 Topic: The Internal Energy of an Ideal Gas Type: Numerical

59 Two containers of equal volume are connected by a stopcock as shown below. One container is filled with a gas at a pressure of 1 atm and temperature of 293 K while the other container is evacuated so that it is under vacuum. The containers are thermally isolated from the surrounding so no heat enters or escaped from the system. The stopcock is then opened allowing the gas from one container to fill the other. What is the final temperature of the gas after it has come to equilibrium?



A) 136.5 K B) 273 K C) 293 K D) 195 K E) undetermined

Ans: C

Section: 18–4 Topic: The Internal Energy of an Ideal Gas Type: Numerical

60 In a certain thermodynamic process, 1000 cal of heat are added to a gas confined in a cylinder. At the same time, 1000 J of work are done by the gas as it expands. The increase in internal energy of the gas is

A) zero B) 3186 J C) –239 J D) 5186 J E) 1239 J

Ans: B

Section: 18–4 Topic: The Internal Energy of an Ideal Gas Type: Numerical

62 In a certain thermodynamic process, 20 cal of heat are removed from a system and 30 cal of work are done on the system. The internal energy of the system

A) increases by 10 cal.
B) decreases by 10 cal.
C) increases by 50 cal.
D) decreases by 50 cal.
E) decreases by 20 cal.

Ans: A

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Conceptual

64 An ideal gas undergoes a cyclic process in which total (positive) work W is done by the gas. What total heat is added to the gas in one cycle?

A) W B) $-W$ C) zero D) $2W$ E) $W/2$

Ans: A

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Conceptual

66 The pressure of a gas in an isobaric expansion remains constant. In such an expansion,

A) no work is done.
B) work is done by the gas.
C) work is done on the gas.
D) "isobaric" and "expansion" are contradictory terms.
E) work is or is not done depending on whether the temperature of the gas changes.

Ans: B

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

68 The work done by an ideal gas in an isothermal expansion from volume V_1 to volume V_2 is given by the formula:

$$W = nRT \ln(V_2/V_1)$$

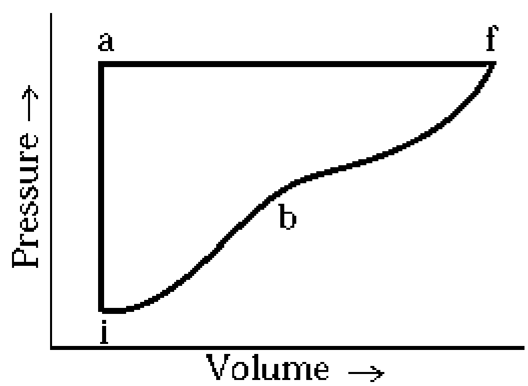
Standard atmospheric pressure (1 atm) is 101.3 kPa. If 1.0 L of He gas at room temperature (20ºC) and 1.0 atm of pressure is compressed isothermally to a volume of 100 mL, how much work is done on the gas?

A) 5.6 kJ B) 4.7×10^2 J C) 4.7×10^2 kJ D) 2.3×10^2 kJ E) 2.3×10^2 J

Ans: E

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

69



An ideal gas system changes from state i to state f by paths iaf and ibf. If the heat added along iaf is Q_{iaf} = 50 cal, the work along iaf is W_{iaf} = 20 cal. Along ibf, if Q_{ibf} = 40 cal, the work done, W_{ibf}, is

A) 10 cal B) 20 cal C) 30 cal D) 40 cal E) 50 cal

Ans: A

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

80 The equation of state for a certain gas under isothermal conditions is

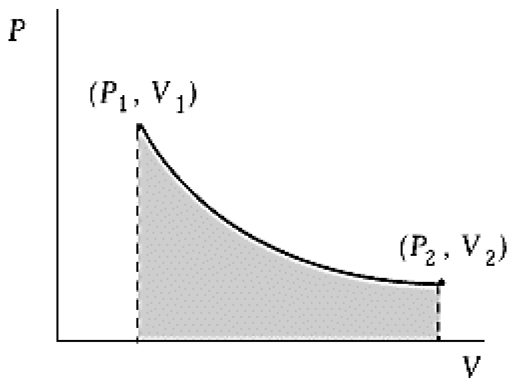
$$PV = 31.2,$$

where the units are SI. The work done by this gas as its volume increases isothermally from 0.2 m^3 to 0.8 m^3 is approximately

A) 2.86 J B) 28.6 J C) 43.3 J D) 71.8 J E) 115 J

Ans: C

Use the following to answer questions 82-86:



Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

82 An ideal gas initially at 50ºC and pressure P_1 = 100 kPa occupies a volume V_1 = 3 L. It undergoes a quasi-static, isothermal expansion until its pressure is reduced to 50 kPa. How much work was done by the gas during this process? R = 8.314 J/mol·K = 8.206 L·atm/mol·K.

A) 116 J B) 208 J C) 256 J D) 304 J E) 416 J

Ans: B

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

83 An ideal gas initially at 50ºC and pressure P_1 = 250 kPa occupies a volume V_1 = 4.5 L. It undergoes a quasistatic, isothermal expansion until its pressure is reduced to 150 kPa. How much work was done by the gas during this process? R = 8.314 J/mol·K = 8.206 L·atm/mol·K.

A) 116 J B) 320 J C) 575 J D) 640 J E) 850 J

Ans: C

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

84 An ideal gas initially at 100ºC and pressure P_1 = 250 kPa occupies a volume V_1 = 4.5 L. It undergoes a quasistatic, isothermal expansion until its pressure is reduced to 150 kPa. How much does the internal energy of the gas change during this process? R = 8.314 J/mol·K = 8.206 L·atm/mol·K.

A) 116 J
B) 320 J
C) 575 J
D) 640 J
E) The internal energy does not change during this process.

Ans: E

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

86 An ideal gas initially at 100ºC and pressure P_1 = 250 kPa occupies a volume V_1 = 4.5 L. It undergoes a quasistatic, isothermal expansion until its pressure is reduced to 150 kPa. How much heat enters the gas during this process? R = 8.314 J/mol·K = 8.206 L·atm/mol·K.

A) 116 J B) 320 J C) 575 J D) 640 J E) 850 J

Ans: C

Section: 18–5 Topic: Work and the PV Diagram for a Gas Type: Numerical

88 An ideal gas initially at 50ºC and pressure P_1 = 100 kPa occupies a volume V_1 = 3 L. It undergoes a quasistatic, isothermal expansion until its pressure is reduced to 50 kPa. How much heat enters the gas during this process? R = 8.314 J/mol·K = 8.206 L·atm/mol·K.

A) 116 J B) 208 J C) 256 J D) 304 J E) 416 J

Ans: B

Section: 18–6 Topic: Heat Capacities of Gases Type: Numerical

91 The internal energy for a diatomic gas is given by U = 5nRT/2. Calculate the internal energy of a 100 g mixture of oxygen (20%) and nitrogen (80%) gas at 25°C. (The molar weight of O_2 = 32 g, and the molar weight of N_2 = 28 g.)

A) 21.6 kJ B) 1.80 kJ C) 12.1 kJ D) 13.0 kJ E) 1.10 kJ

Ans: A

Section: 18–6 Topic: Heat Capacities of Gases Type: Numerical

96 A gas has a molar heat capacity at constant volume of 28.39 J/mol · K. Assume the equipartition theorem to be valid. How many degrees of freedom (including translational) are there for the molecules of this gas? (the ideal-gas law constant is R = 8.31 J/mol · K)

A) 1 B) 3 C) 4 D) 5 E) 7

Ans: E

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Conceptual

49 The change in the entropy of the universe due to an operating Carnot engine

A) is zero.
B) must be positive.
C) must be negative.
D) could be positive or negative.
E) is meaningless to consider, because a Carnot engine has no connection to entropy.

Ans: A

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Numerical

51 A car of mass 2000 kg is traveling at 22.0 m/s on a day when the temperature is 20.0ºC. The driver steps on the brakes and stops the car. By how much does the entropy of the universe increase?

A) 1.6 kJ/K B) 24 kJ/K C) 4.8×10^5 J/K D) 0.15 kJ/K E) 3.3 kJ/K

Ans: A

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Numerical

52 A steam power plant with an efficiency of 65% of the maximum thermodynamic efficiency operates between 250º C and 40ºC. What is the change in the entropy of the universe when this plant does 1.0 kJ of work?

A) 16 J/K B) 1.7 J/K C) 55 J/K D) 1.7 mJ/K E) 0.85 J/K

Ans: B

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Numerical

53 One mole of an ideal gas undergoes a reversible isothermal expansion from a volume of 1 L to a volume of 2 L. The change in entropy of the gas in terms of the universal gas constant *R* is

A) $R/2$ B) $2R$ C) $R \ln(2)$ D) $R \ln(½)$ E) None of these is correct.

Ans: C

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Numerical

55 Two moles of a gas at $T = 350$ K expand quasistatically and isothermally from an initial volume of 20 L to a final volume of 60 L. The change in entropy of the gas during this expansion is ($R = 8.314$ J/mol·K)

A) –17.4 J/K B) 18.3 J/K C) 20.4 J/K D) –24.6 J/K E) 27.8 J/K

Ans: B

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Numerical

56 Three moles of a gas at T = 250 K expand quasi-statically and adiabatically from an initial volume of 30 L to a final volume of 60 L. The change in entropy of the gas during this expansion is (R = 8.314 J/mol·K)

A) 17.3 J/K B) 18.6 J/K C) –17.4 J/K D) 19.5 J/K E) zero
Ans: E

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Numerical

57 A container has 0.2 mole of O_2 gas and the gas is heated from 0°C to 100°C. What is the change in entropy of the gas? (R = 8.314 J/mol·K)
A) 1.82 J/K B) 1.30 J/K C) 0.78 J/K D) 26.8 J/K E) zero
Ans: A

Section: 19–5 Topic: Irreversibility, Disorder, and Entropy Type: Numerical

58 A block of mass m = 0.2 kg slides across a rough horizontal surface with coefficient of kinetic friction μ_k = 0.5. What is the change in entropy after the block has moved a distance of 1 m? The temperature of the block and surrounding is 22°C.
A) 4.5×10^{-2} J/K B) 3.3×10^{-3} J/K C) 6.7×10^{-3} J/K D) 9.0×10^{-3} J/K E) zero
Ans: B